ANASIEZE IKENNA – CLOUD & AI ENGINEER

Project: Cloud SQL Data Pipeline & Analytics Project

Overview

This guide provides a comprehensive walkthrough of a cloud-native data engineering project built on Google Cloud Platform (GCP).
For technical teams: Detailed commands, code snippets, and architectural diagrams.
For non-technical teams: Business context, impact analysis, and visual workflows.

Business Problem

Airlines and transportation agencies need to analyze flight performance, delays, and operational efficiency across 300,000+ flight records to optimize routes, reduce costs, and improve passenger experience.

Technical Solution

A scalable ETL pipeline that:
1. Extracts flight data from public sources.
2. Transforms and loads it into Cloud SQL (PostgreSQL).
3. Analyses data using SQL to generate actionable insights.

Architecture Diagram

[Cloud Storage: Raw CSV Files]
↓
[Cloud SQL: Data warehouse]
↓
[SQL Analytics: Query]
↓
[Dashboards & Reports]

Step-by-Step Setup

⇒ **Prerequisites**

- Google Cloud Platform account
- Basic knowledge of SQL and command line
- Access to Cloud Shell

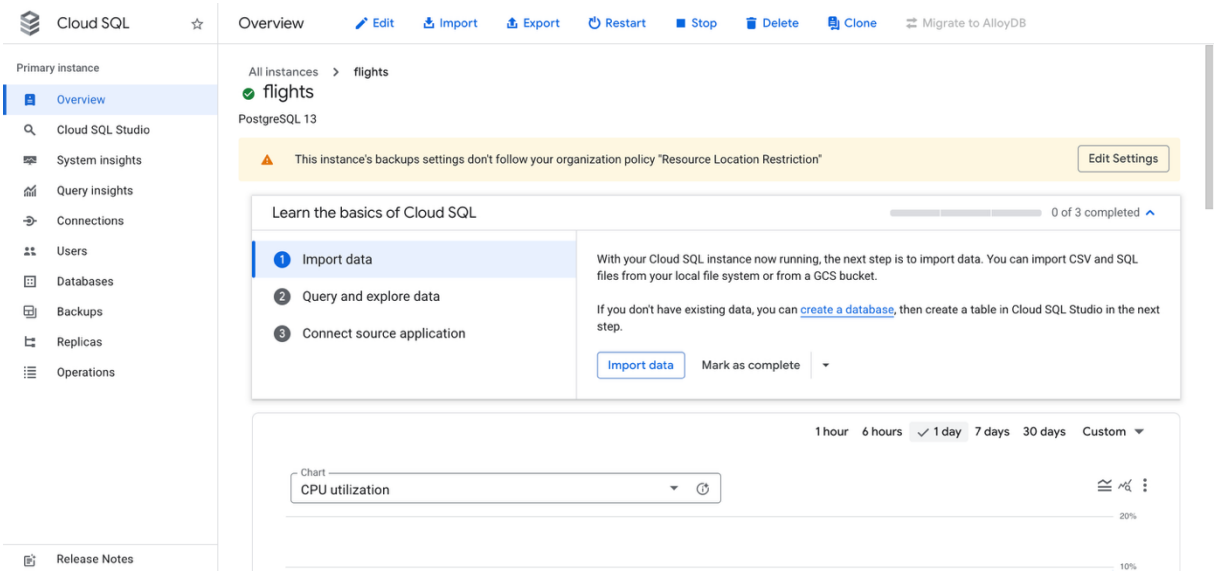
⇒ **Environment Setup**

Step 1: Launch Cloud Shell
1. Log into [Google Cloud Console](https://console.cloud.google.com).

2. Click the Cloud Shell icon.

Step 2: Create Cloud SQL Instance

```bash
gcloud sql instances create flights \
 --database-version=POSTGRES_13 \
 --cpu=2 \
 --memory=8GiB \
 --region=us-central1 \
 --root-password="Your secure password"
```



Non-Technical Explanation:
This command provisions a managed PostgreSQL database with 2 CPUs and 8GB RAM, located in Iowa (us-central1). It's like renting a secure, scalable database server in the cloud.

Step 3: Prepare Cloud Storage

```bash
 Create a unique bucket for data files
export PROJECT_ID=$(gcloud info --format='value(config.project)')
export BUCKET=${PROJECT_ID}-flight-data
```

Non-Technical Explanation:
Creates a cloud storage folder (bucket) to hold raw flight data files.

⇒ **ETL Pipeline Development**

Data Extraction
For Technical Teams

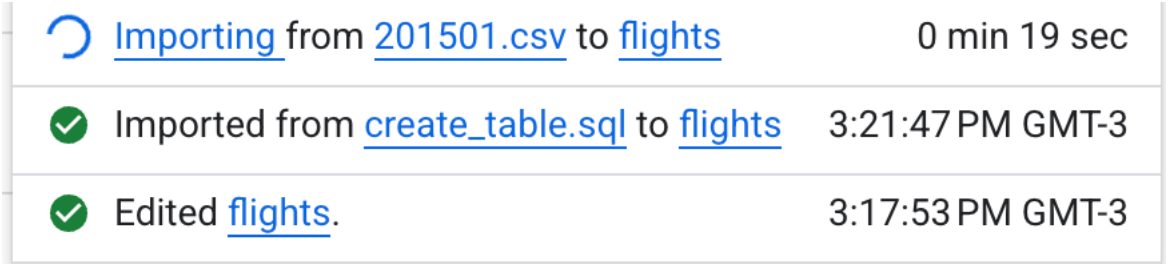
```bash
# Download sample flight data
wget https://storage.googleapis.com/cloud-training/OCBL013/nycflights13.csv
# Upload to Cloud Storage
gsutil cp nycflights13.csv gs://$BUCKET
```

For Non-Technical Teams
- Data is sourced from the US Bureau of Transportation Statistics.
- Files are automatically transferred to secure cloud storage.

⇒ **Data Loading into Database**

Step 1: Create Table Schema
Technical Code:
```sql
-- create_table.sql
CREATE TABLE flights (
  "Year" TEXT,
  "Quarter" TEXT,
  "Month" TEXT,
);
```

Step 2: Import Data
```bash
# Import CSV into PostgreSQL
gcloud sql import csv flights \
  gs://$BUCKET/nycflights13.csv \
  --database=postgres \
  --table=flights
```



Non-Technical Explanation:
This step loads the flight records into the database table, similar to importing a spreadsheet into a more powerful analysis tool.

⇒ **Database Analytics**

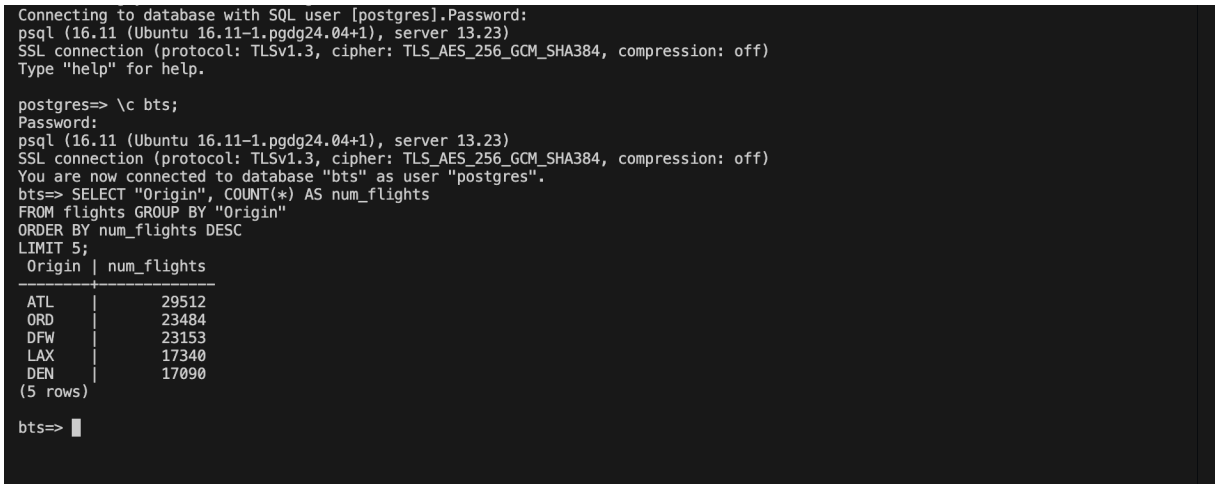
Key Business Queries

Query 1: Top 3 Busiest Airports

```sql
SELECT "Origin",  COUNT() AS num_flights
FROM flights
GROUP BY "Origin"
ORDER BY num_flights DESC
LIMIT 3;
```

Output:

Origin	Num_flights
ATL	29,512
ORD	23,484
DFW	23,153



Query 2: Average Delay by Airline

```sql
SELECT "Reporting_Airline",
    AVG("DepDelayMinutes") AS avg_delay
FROM flights
GROUP BY "Reporting_Airline"
ORDER BY avg_delay DESC;
```

Business Insight: Identifies airlines with frequent delays for operational reviews.

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